S5102-RX

ERROR RATE TEST SET
RECEIVER

PRELIMINARY INSTRUCTION MANUAL

FORM 196-481B

tau-tron

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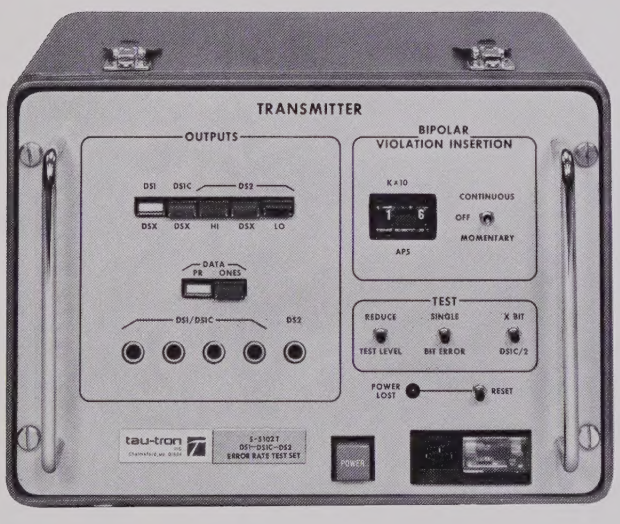
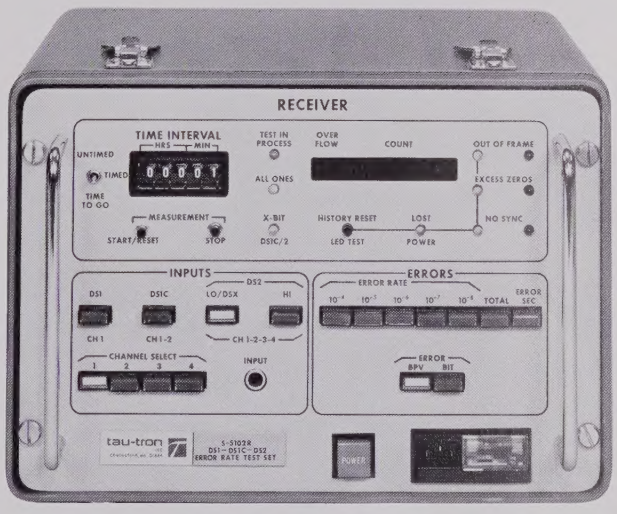




- For DS1, DS1C, and DS2 testing
- Measures both bit errors and bipolar violations
- Measures total errors, error rate, and error-seconds simultaneously
- Standard $2^{20}-1$ pseudorandom sequence or all one's data
- Long-term testing via built-in timer
- Standard Bell interface levels and framing format
- Confidence in data with latching status indicators
- Meets KS-22331/2 L1, compatible with KS-KS-20775 L2

The S5102 fits in anywhere—almost everywhere.

The new generation of M13 multiplexers are constructed to allow an interface at standard DS1, DS1C and DS2 rates. Most new M13 multiplexers consist of an M12 in tandem with an M23 and some are constructed in various combinations of an M1C or M12 to M23.

The Tau-Tron S5102 is the first digital test set that allows isolation of a system problem to the transmitter, receiver, or transmission path without ambiguity.

System End-to-End: This is considered to be the standard test for end-to-end performance.

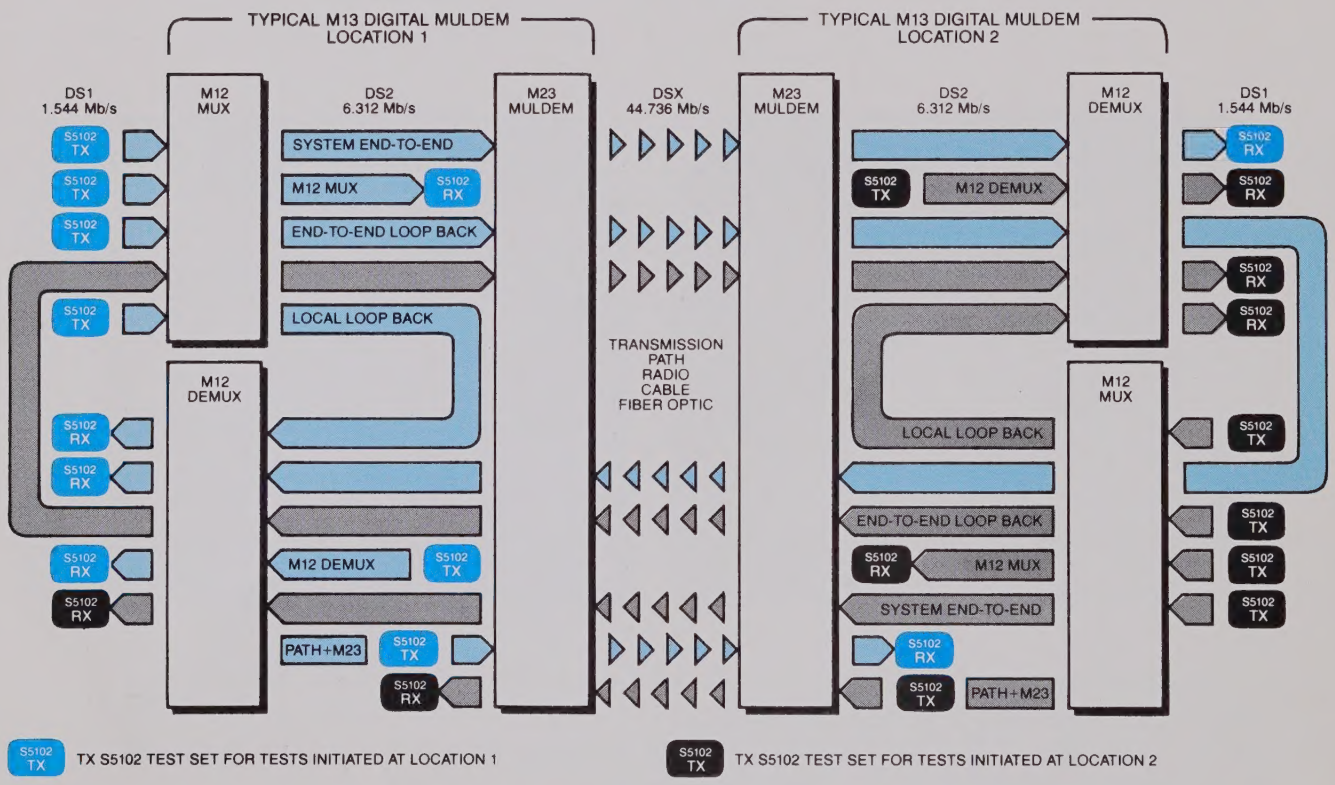
M12 Mux (M13 insert): The S5102 can provide from one to four DS1 test channels, with or without live traffic to the other DS1 inputs of the M12 (insert) section. System problems can be isolated to this section because the S5102 receiver can receive the multiplexed signal at DS2 and then demultiplex and test each of the four DS1 channels.

End-to-End Loop Back: This is a test of end-to-end performance that can be performed at one location. The transmitter can either send at the DS1 rate or the DS2 rate.

Local Loop Back: Although this is not a normal configuration of the system it can prove of considerable value in certain situations.

M12 DeMux (M13 drop): In this test the demux can be tested locally and therefore isolated. This test again demonstrates the flexibility of the S5102 in being able to transmit at one frequency and receive at another.

Path + M23: The DS2 test signal from the S5102 Transmitter is multiplexed with the other DS2 inputs (live traffic) and transmitted to the far end where each of its DS1 channels can be tested with the S5102 Receiver connected at the cross-connect point.



- **Tests through M1C, M12, and M13 low-speed section multiplexers**
- **Tests drop and insert of M13 multiplexers**
- **Tests T-carrier span lines**
- **Tests fiber optic systems**
- **Tests automatic protection switches**

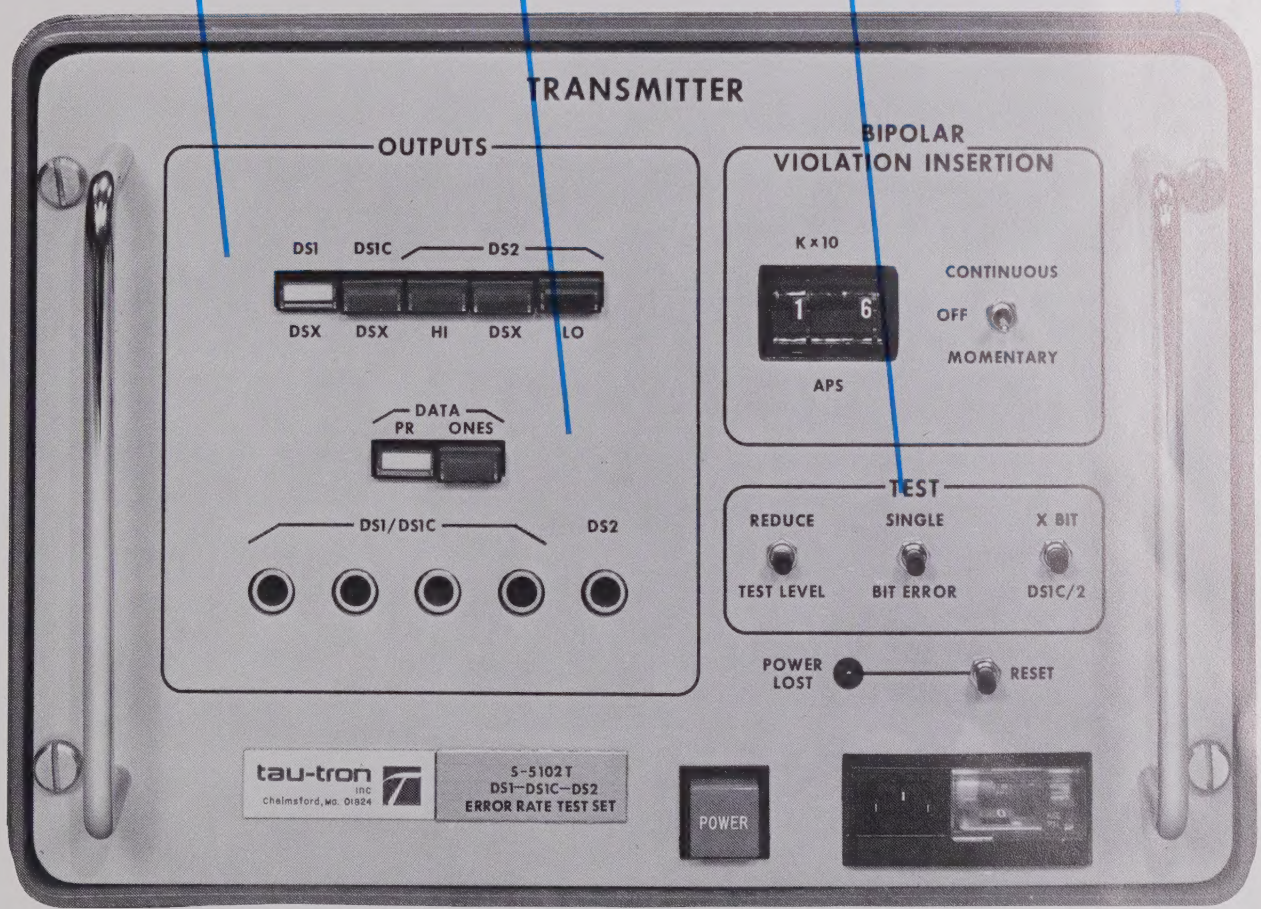
The Tau-Tron S5102 Error Rate Test Set is a compact, portable test set for measurements of systems operating at the DS1, DS1C, and DS2 transmission rates. Because it can insert a test signal at one rate and test at another, it is one of the first field instruments that can completely test M1C, M12, and the low-speed sections of most M13 multiplexers. It can perform standard end-to-end and loop-back tests on digital radio, fiber optic,

Simplified Rate and Level Selection: Output rate and level are easily selected by means of five pushbuttons. An additional switch allows further reduction in the output for test-set back-to-back measurements as a check on test-set performance.

Pushbutton Code Choice: Two pushbuttons control the output data content as pseudorandom of $2^{20}-1$ bits or as all ones. An all-ones unframed pattern, useful for standard power measurements, is available via a rear-panel switch and the front-panel all-ones push button.

Error Insertion: Bipolar violations can be inserted momentarily or continuously at rates from 1×10^{-8} to 9×10^{-3}. Single bit errors can be injected simultaneously into each DS1 channel and the X-bit can be set to a logic-0 to simulate an alarm.

Rugged, Portable: Both units are ruggedly built for reliable operation from site to site. Each includes a cover that provides complete protection during transit.



and T-carrier systems, and is fully compatible with all T1 bit-error-rate test sets currently in use.

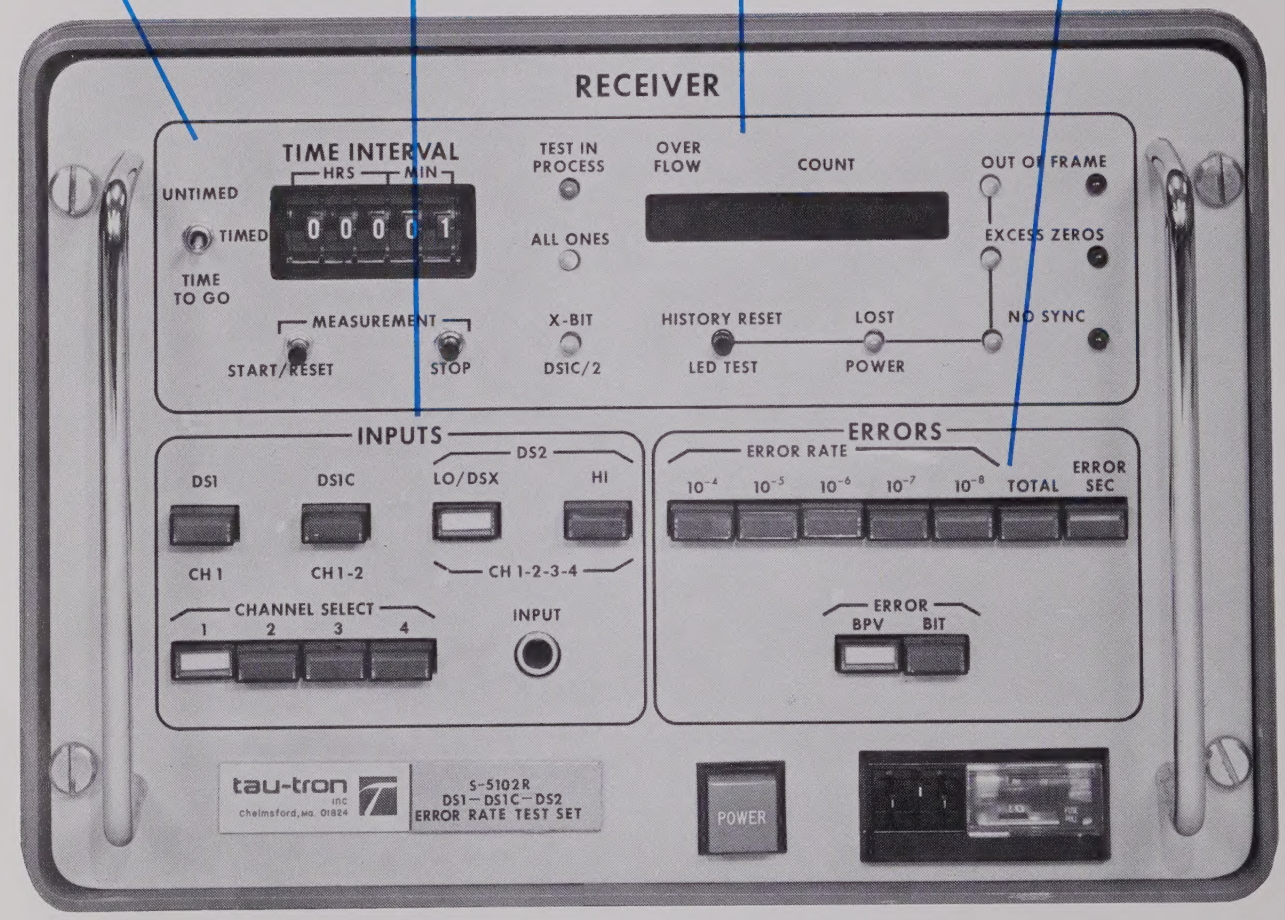
The transmitter unit generates a standard $2^{20}-1$ pseudorandom sequence with 15-zero suppression. The transmitter actually multiplexes the basic DS1 channel to provide two DS1 test channels in a true formatted DS1C output with framing. Similarly, it multiplexes the basic DS1 channel to provide four DS1 test channels in a true formatted DS2 output with framing. The receiver unit can receive at DS1, DS1C, and DS2, demultiplex to DS1, and make simultaneous measurements of total errors, error rate, and synchronous error seconds for both bit errors and bipolar violations. Both units meet rigid Bell KS specifications and incorporate features that allow for simplicity of operation and confidence in the measurements performed.

Elapsed Time: Measurements can be initiated and stopped manually or, by means of a built-in timer, initiated manually and stopped automatically up to 1,000 hours later.

Input Selection: Input type and level selection is a simple matter of pushing a button or two—DS1, DS1C, or DS2 LO/DSX or HI, channels 1 through 4.

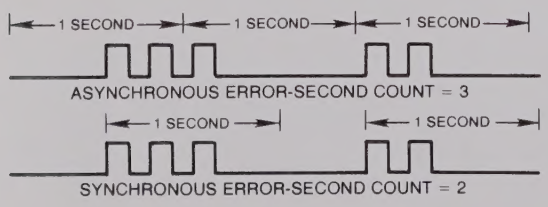
High-Confidence Answers: A bright, 5 digit display, plus overflow, provides all measurement values. In addition, latching status indicators warn of lost ac power during a test, out of frame, excess zeros, no sync, and other conditions that could compromise a test.

Complete Error Measurements: Pushbuttons allow a choice of bit or bipolar errors—total, synchronous error seconds, or error rate with a range of 10^{-4} to 10^{-9}.



A Note about Error-Second Measurements

Two types of error-second measurements are in general use, asynchronous and synchronous.

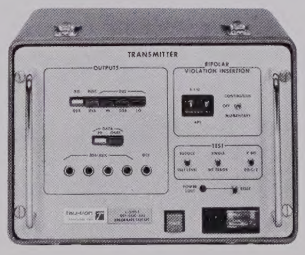


With asynchronous measurements, contiguous one-second measurements are made starting at some time independent of the errors. Any error or errors occurring during any one-second interval registers as an error-second. With synchronous measurements, the one-second measurements are triggered by the errors.

Synchronous errored-second measurements always give the lowest possible count and always give consistent counts—two test sets making the same measurement will always read the same. For these reasons they are preferred by industry and are the type used by Tau-Tron.

TRANSMITTER SPECIFICATIONS
(S5102 TX)

	DS1	DS1C	DS2
Composition	One DS1 Channel	Two DS1 Channels Channels are scrambled and multiplexed according to Bell convention.	Four DS1 Channels
Rate	1.544 Mbits/s, ± 50Hz at 25°C	3.152 Mbits/s, ± 50Hz at 25°C	6.312 Mbits/s, ± 50Hz at 25°C
Stability	± 10 ppm from 0–50°C, ± 1 ppm aging rate per month		
Data Patterns	Pseudorandom of $2^{20}-1$ (1,048,765) bits or continuous all one's, front-panel pushbutton selected.		
Code	AMI (alternate mark inversion)	AMI (alternate mark inversion)	B6ZS (bipolar six-zero substitution)
Level HI	—	—	2.1 ± 0.25V
Reduced HI	—	—	40 dB below HI level
DSX	3 ± 0.3V	3 ± 0.3V	HI output attenuated by equivalent of 1000 ft of ABAM cable
Reduced DSX	24 dB below DSX level	24 dB below DSX level	40 dB below DSX level
LO	—	—	HI output attenuated by 6dB plus equivalent of 2000 ft of ABAM cable
Shape	Conforms to Bell specifications for an isolated DS1 pulse measured at the cross-connect point	Conforms to Bell specifications for an isolated DS1C pulse measured at the cross-connect point	DSX-2 conforms to Bell specifications for an isolated DS2 pulse measured at the cross-connect.
Impedance	110 Ω, balanced	110 Ω, balanced	110 Ω, balanced
Return Loss	⩾ 26 dB from 0.3 to 6.3 MHz		⩾ 26 dB from 1.2 to 12.6 MHz
Connector	Four separate Weco 310 connectors		Single Weco 310 connector
X-Bit Control		X-bit changes from a logic–1 to a logic–0 while the front-panel switch is depressed.	
Error Injection Bit Bipolar	A single bit error is simultaneously injected into the pseudorandom data patterns of each DS1 channel each time the front-panel switch is depressed. Momentary or continous violations inserted at rates of 1×10^{-8} to 9×13^{-3} as set by front panel thumbwheel switches.		



APS Input: For use with S5102-RX only, rear-panel Weco 310 connector; both clock and data output aids testing certain types of T-1 carrier, span system automatic protection switches.

Power: 115V ± 10% ac, 48 to 66 Hz, 40 VA, via a 6-foot detachable power cord (supplied) that connects to a front-panel connector and is stored in the cover when not in use. Lost Power LED lights following restoration of power after a low or lost-power condition.

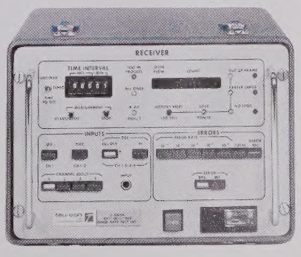
Mechanical: Portable bench-top grey-painted aluminum case with protective cover. Convenient carrying handle mounted on cover. Adaptor available for rackmounting; see Option 05. ***DIMENSIONS:*** 9.2 in. high × 13.25 in. wide × 11.5 in. deep overall including cover and handle. ***WEIGHT:*** 16 lb net, 21 lb shipping.

Accessories Supplied: Power cord, protective cover, instruction manual, and spare fuse.

Accessories Available: Hard-shell shipping case and soft carrying case.

Option 05 Rackmounting: Adapts unit for mounting in a standard 19-in. rack.

RECEIVER SPECIFICATIONS
(S5102 RX)



Input: Input can be DS1, DS1C, or DS2, as selected by front-panel pushbuttons and applied to a front-panel Weco 310 connector with 110 ohms balanced input and ⩾ 26dB return loss from 0.3 to 12.6MHz. (clock is recovered from signal.) ***DS1 INPUT:*** ± 0.19 to 3V (works with up to 750 ft of ABAM cable). ***DS1C INPUT:*** ± 0.19 to 3V (works with up to 655 ft of ABAM cable). ***DS2 INPUT:*** HI input is 0.21 to 2.1V, LO input is 1.05 to 2.1V (works with up to 2100 ft of ABAM cable), DSX input is 0.021 to 2.1V (works with up to 1000 ft of ABAM cable).

Channels: Front-panel pushbuttons select channels 1 (DS1), 1 and 2 (DS1C), and 1, 2, 3 and 4 (DS2). Display flashes for invalid channel selection.

Error Determination: ***BIT ERROR:*** Inequality between received DS1 data pattern and receiver's internally generated DS1 data pattern. ***BIPOLAR:*** Bipolar violations detected on live traffic or test patterns; AMI for DS1 and DS1C, B6ZS for DS2.

Timing Modes: One of two timing modes can be selected by a

front-panel control, untimed and timed. *UNTIMED:* Counters operate without regard to time and are controlled by the front-panel Start/Reset control. *TIMED:* Counters start operation when Start/Reset control is depressed and stop when Stop control is depressed or after a length of time as set on five front-panel thumbwheel switches from 1 min to 999 hr 99 min.

Error Measurements: Three different measurements are made simultaneously, displayed separately: *TOTAL:* Bit errors and bipolar violations are counted up to 99,999, plus overflow. *ERROR SECONDS:* Synchronous error-seconds are counted up to 99,999, plus overflow. *ERROR RATE:* Range set by front-panel pushbutton in 5 ranges of 10^{-4} to 10^{-8}; error rate is displayed as 3 digits. Count is updated at the end of 1s except for 10^{-7} range where it is 6.5s for bit errors and DS1 bipolar errors, 3.2s for DS1C bipolar errors and 1.6s for DS2 bipolar errors; and the 10^{-8} range where it is 10 × the 10^{-7} values.

Display: 5-digit, high-brightness, with 0.270 in. high digits, plus overflow; provides indication of bit or bipolar errors as a total, a rate, or as error-seconds, as selected by front-panel pushbuttons. Time remaining for timed measurements can also be selected.

Status: Seven events are indicated by front-panel LEDs, three of which include both a current status and history status (event has occurred at least once since last manual reset). A front-panel control illuminates all LEDs when depressed, as a test, and resets the history indicators. *OUT OF FRAME:* (Current and history) for DS1C lost M1C frame or DS2 lost M12 frame. *EXCESS ZEROS:* (Current and history) for DS1 16 consecutive zeros, DS1C 32 consecutive zeros, and DS2 6 consecutive zeros. *NO SYNC:* (Current and history) loss of pseudorandom data detected after decoding input to DS1 channel. *LOST POWER:* (history) Illuminated following low or lost ac power. *TEST IN PROGRESS:* Illuminated for duration if timed test, extinguishes momentarily for rate measurements when display is updated. *ALL ONES:* (Current) Illuminates when DS1 channel is all ones. *X-BIT:* (Current) Illuminates when X-bit in framing is logic 0 for DS1C and DS2 inputs.

Signal Monitors: Five separate BNC connectors provide output signals of 2.5V into 75 ohms for recovered clock, bit errors, M-sync (once per M frame), pseudorandom sync (once per word sequence), and count (one output pulse per error count being displayed).

APS Output: For use with S5102 TX only, rear-panel Weco 310 connector; clock and data aids testing certain types of T1-carrier, span, system automatic protection switches.

Power: 115V ± 10% ac, 48 to 66 Hz, 40 VA, via a 6-foot detachable power cord (supplied) that connects to a front-panel connector and is stored in the cover when not in use. Lost Power LED lights following restoration of power after a low or lost-power condition.

Mechanical: Portable bench-top gray-painted aluminum case with protective cover. Convenient carrying handle mounted on cover. Adaptor available for rack-mounting; see Option 05. *DIMENSIONS:* 9.2 in. high × 13.25 in. wide × 11.5 in. deep overall including cover and handle. *WEIGHT:* 16 lb. net, 21 lb. shipping.

Accessories Supplied: Power cord, protective cover, instruction manual, and spare fuse.

Accessories Available: Hard-shell shipping case and soft carrying case.

Option 05 Rackmounting: Adapts unit for mounting in a standard 19-in. rack.

S5102-TX Error Rate Test Set Transmitter
S5102-RX Error Rate Test Set Receiver

Options for added capability:
OP-05 Rackmounting

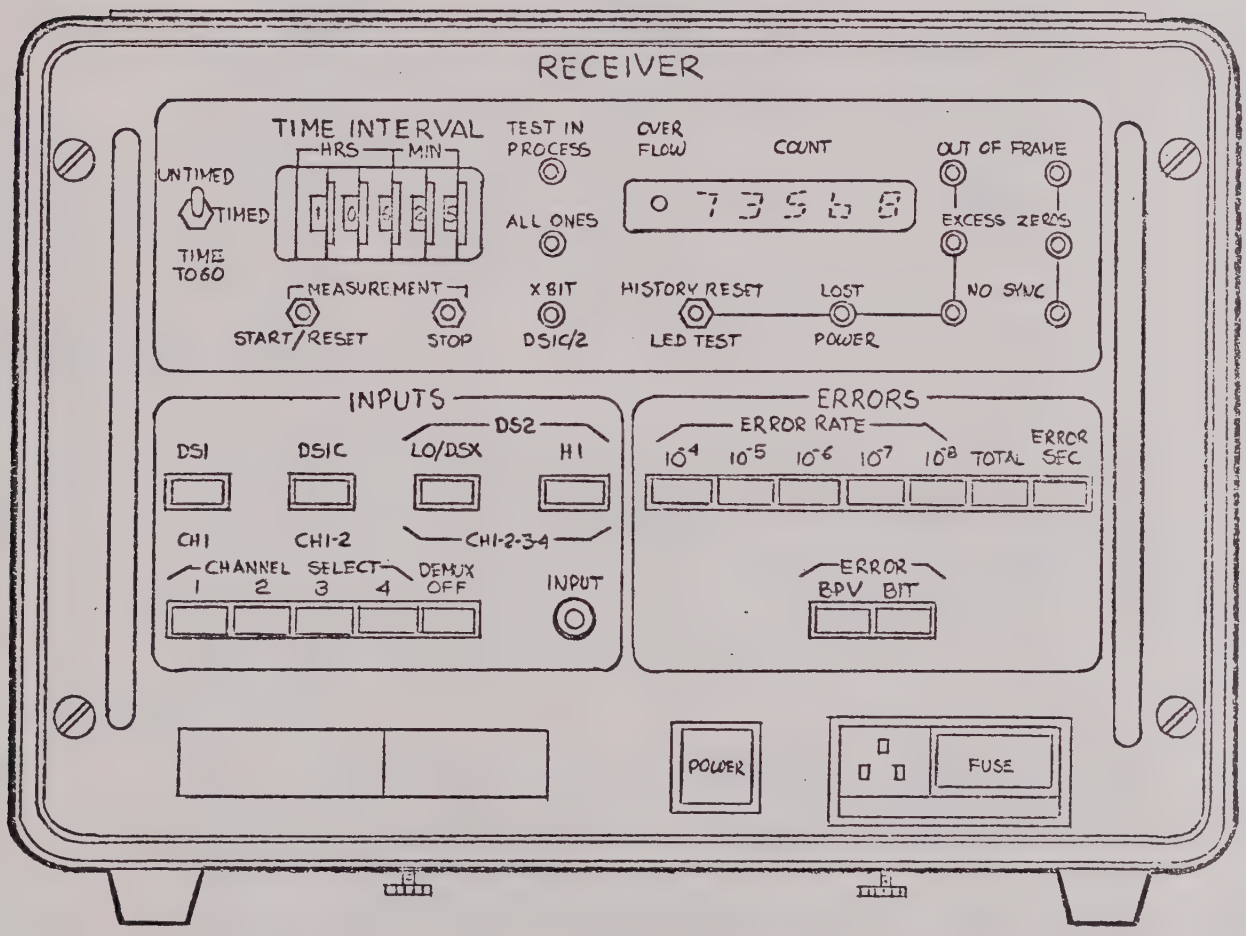
Accessories Available:
Hard-Shell Shipping Case
Soft Carrying Case

Specifications subject to change without notice.

tau-tron
Tau-Tron Inc. 27 Industrial Ave., Chelmsford, MA 01824
(617) 256-9013 TWX: 710-343-6781

Form 150-1080B Printed in U.S.A.

FRONT PANEL


RECEIVER
TIME INTERVAL
HRS
MIN
UNTIMED
TIMED
TIME TO GO
MEASUREMENT
START/RESET
STOP
TEST IN PROCESS
ALL ONES
X BIT
DSIC/2
OVER FLOW
COUNT
0 7 3 5 6 8
HISTORY RESET
LED TEST
LOST POWER
OUT OF FRAME
EXCESS ZEROS
NO SYNC
INPUTS
DS1
DSIC
DS2
LO/DSX
HI
CH1
CH1-2
CH1-2-3-4
CHANNEL SELECT
1 2 3 4
DEMUX OFF
INPUT
ERRORS
ERROR RATE
10⁻⁴ 10⁻⁵ 10⁻⁶ 10⁻⁷ 10⁻⁸ TOTAL
ERROR SEC
ERROR
BPV BIT
POWER
FUSE

INPUTS

	DS1	DS1C	DS2
Composition Demux on	One DS1 channel Unframed Out-of-Frame alarms inhibited Channel 1	Two DS1 channels Framed* Out-of-Frame alarms active Channels 1,2	Four DS1 channels Framed* Out-of-Frame alarms active Channels 1,2,3,4
DEMUX OFF	DS1 Rate Unframed Out-of-frame alarms inhibited	DS1C Rate Unframed Out-of-frame alarms inhibited	DS2 Rate Unframed Out-of-frame alarms inhibited
Code	AMI 15-zero suppression	AMI	B6Z6
Level	DSX	DSX	LO/DSX,HI
Connector	Single Weco 310		

* Demultiplexes, unscrambles, and decodes KS-22331 framed signal.

MEASUREMENT DURATION

Untimed Measurements are initiated manually by the START/RESET button and stopped manually by the STOP button.

Timed Measurements are initiated manually by the START/RESET button and stop automatically after a length of time of from 1 minute to 999 hours and 99 minutes as set by the TIME INTERVAL thumbwheel switches.

The time remaining in a timed test can be obtained from the display by depressing the toggle switch to TIME TO GO.

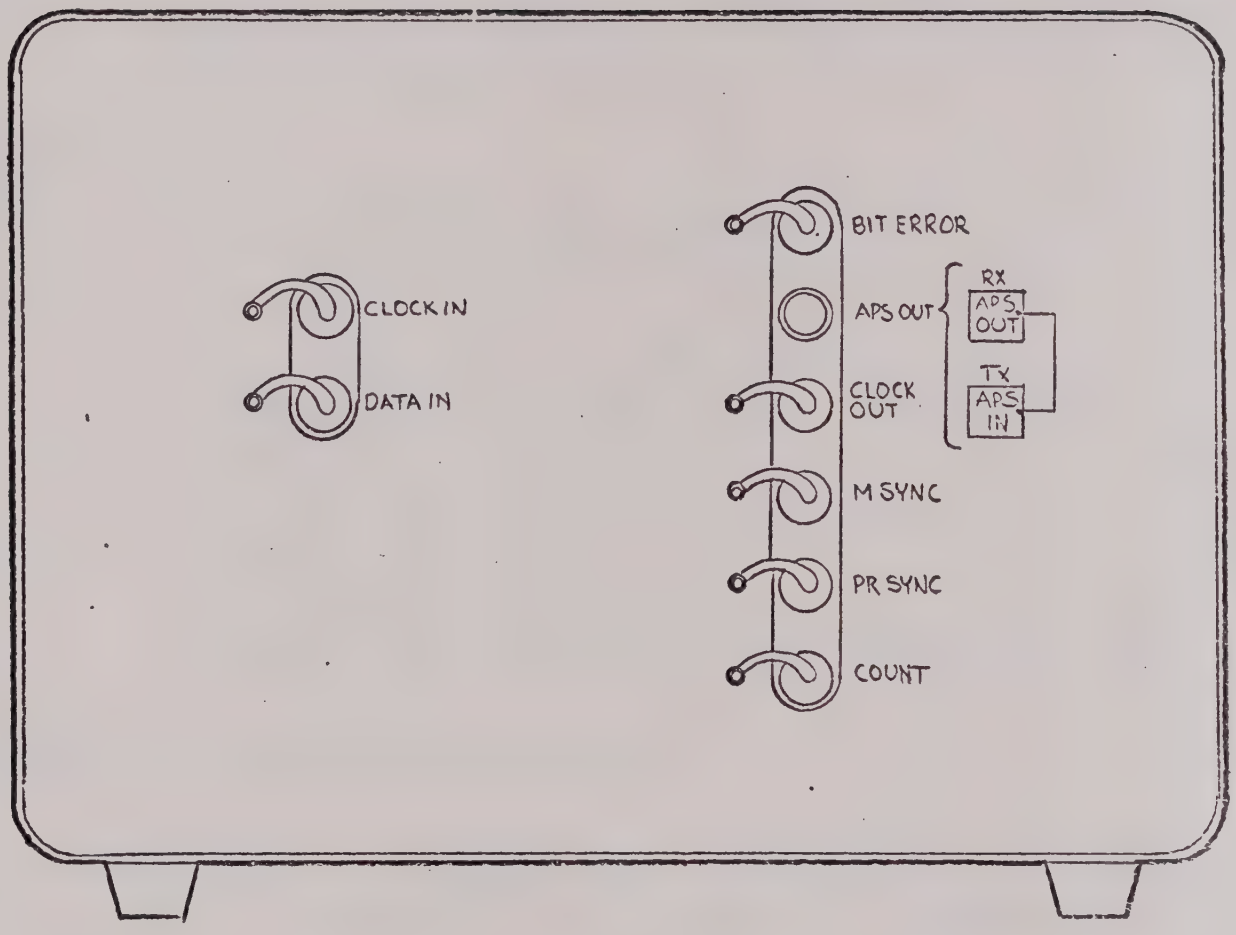
MEASUREMENT RESULTS

BPV,BIT Total bit errors, total bit errored seconds, and bit error rate are measured simultaneously or total bipolar violations, bipolar errored seconds, and bipolar error rate are measured simultaneously, as selected by front-panel pushbuttons.

Display TOTAL, ERROR SEC, RATE 5-digit plus overflow. Can be selected to display total errors, total errored seconds, or error rate of 10^{-4} to 10^{-8}, by front-panel pushbuttons.

Status Test in process, all-ones detected, and X-bit detected (DS1C, DS2 only) are indicated by front-panel indicators. Both current status and history status for out-of-frame, excess zeros, and no sync are indicated by front-panel lamps. Lost power history status is also provided by a front-panel lamp.

REAR PANEL



Data In	NRZ into 75Ω at BNC connector.
Clock In	Into 75Ω at BNC connector.
Clock Out	Recovered clock, 5±0.5V with source impedance of 75Ω at BNC connector.
M Sync Output	5±0.5V with source impedance of 75Ω at BNC connector. Pulse occurs once per master frame with MUX ON at DS1C or DS2 rates.
PR Sync output	5±0.5V with source impedance of 75Ω at BNC connector. Pulse occurs once per PR sequence of $2^{20}-1$.
Bit Error Output	5±0.5V with source impedance of 75Ω at BNC connector. Pulse occurs once per detected bit error independant of front-panel pushbuttons.
Count Output	5±0.5V with source impedance of 75Ω at BNC connector. Pulse occurs once per detected bit error or bipolar violation as set by front-panel pushbuttons.
APS Out	Weco 310 connector. Used with S5102-TX for testing of Automatic Protection Switches (see APS Testing below).

NORMAL TESTING

Demux on — The unit is normally operated with the demux on (one of the CHANNEL SELECT buttons pushed) at the desired rate (DS1,DS1C, DS2) and, for DS2, the desired level (LO/DSX or HI). The input is connected to the output of the system under test.

SPECIAL TESTING

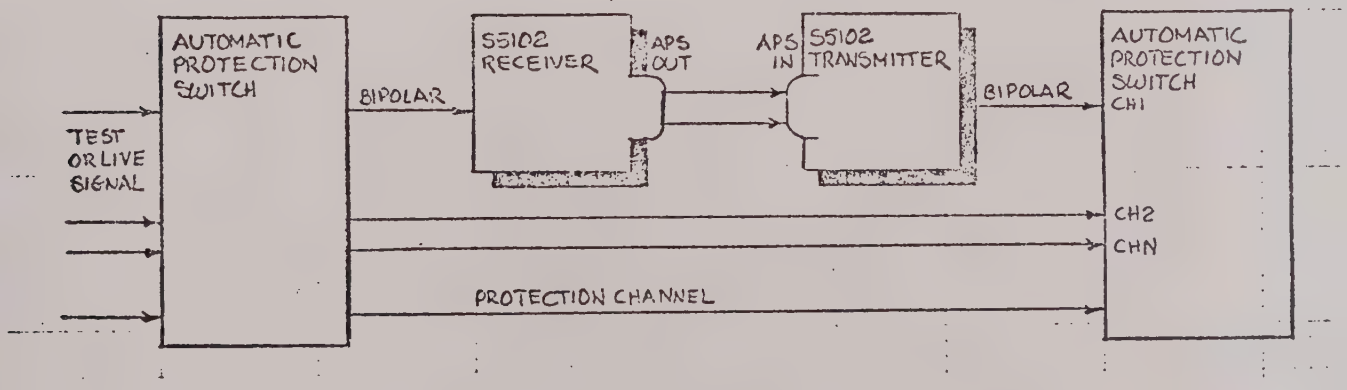
MUX OFF — In some applications, such as fiber-optic or radio links operating at the T2 rate for example, it may be desirable to measure the bit error rate overall transmitter bits rather than on only one of four multiplexed DS1 signals.

In other applications, such as testing system protection switches, it is often beneficial to turn off the framing format. It is not uncommon to measure the switching speed by counting the errors during the switch and converting the count to time. For this type of measurement it is necessary for the test set to aquire data sync much faster than is possible with a framed format.

Deleting the frame format also makes possible the compatibility of the S5102 with other test sets.

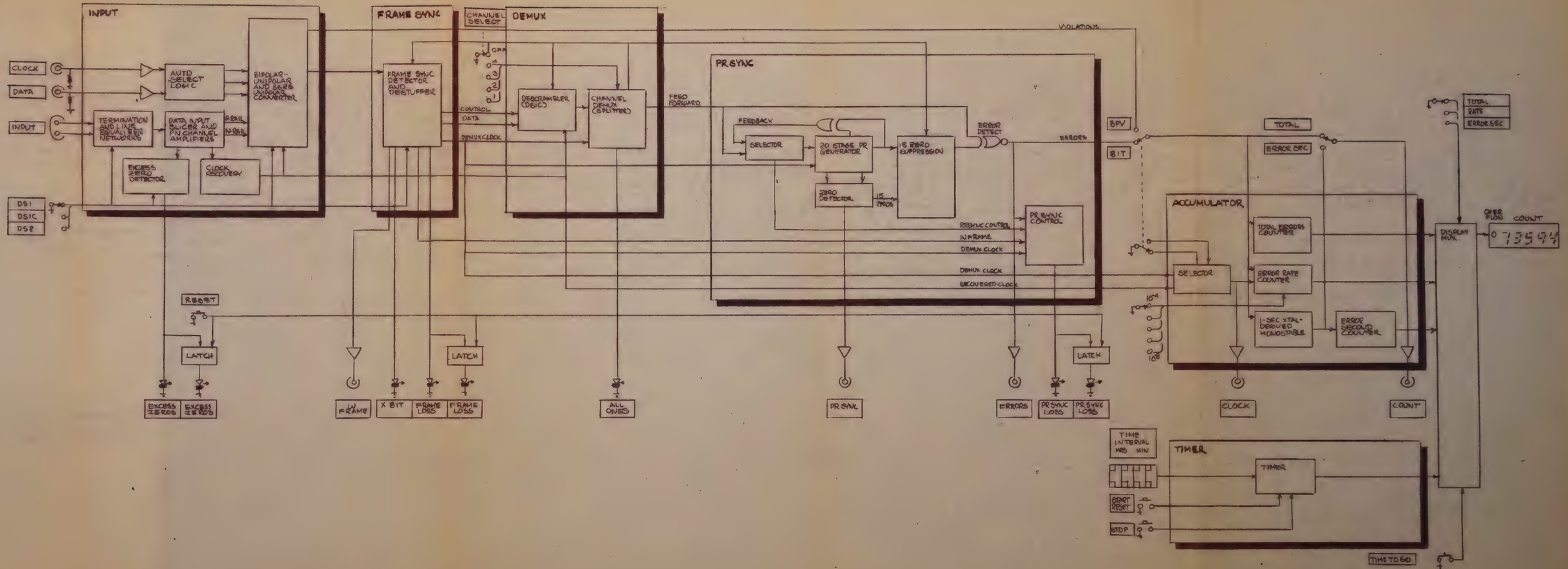
The DEMUX OFF (unframed) mode of the unit offers another practical advantage in that it allows the unit to receive unframed all-one's for output spectral tests as required by KS-22332 Section 3.28.

AUTOMATIC PROTECTION SWITCH TESTING



Data that is received at the bipolar input connector of the receiver appears at the APS OUT connector on the rear panel. The NRZ data and clock from the APS OUT is connected to the transmitter APS IN for reconnecting into a proper bipolar signal.

Bepolar violations can then be inserted on the transmitter output signal at various rates to check trip and reset thresholds of the switch. The test set can also access live traffic in this configuration through a monitor jack for bridging repeater applications or live signal switching tests.



S5102-RX
BLOCK
FIGURE 4

To return a unit for repair:

1. Call the Customer Service Dept., **(617) 256-9013**, for a **Repair Authorization Number.** This will reduce administrative delays and ensure prompt return of your unit.

2. Complete and **attach one of the Repair Tags** below to your unit.

3. **Pack the unit** in the original shipping carton and packaging materials, if available. Otherwise use a double-walled carton (test strength of 350 lb) and shock absorbing material such as bubble wrap to prevent the unit from moving in the carton during transit. Seal with heavy paper tape.

4. **Send to:**

   Tau-Tron
   27 Industrial Ave.
   Chelmsford, MA 01824
   atten: Customer Service

Repair Tag

Repair Authorization Number _____

Model _____ **Serial Number** _____

☐ Warranty repair ☐ Dead on arrival ☐ Repair ☐ Recalibration

Symptoms: _____

_____

Name _____ Title _____

Company _____ Dept./MS _____

Address _____ City _____

State&Zip _____ Phone _____

Form 0163-0281A

Repair Tag

Repair Authorization Number _____

Model _____ **Serial Number** _____

☐ Warranty repair ☐ Dead on arrival ☐ Repair ☐ Recalibration

Symptoms: _____

_____

Name _____ Title _____

Company _____ Dept./MS _____

Address _____ City _____

State&Zip _____ Phone _____

Form 0163-0281A

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27 Industrial Avenue, Chelmsford, MA 01824 (617) 256-9013